Homework 1[*]

CS 719, Semester II, 1996-97

Friday January 24, 1997

1. Formulate the following problems as circulation problems:
   (a) the shortest path problem
   (b) the assignment problem
   (c) the transportation problem
2. Consider a variant of the transportation problem for which
   (a) the sum of demands exceeds the sum of supplies, and
   (b) we incur a penalty p_j for every unit of unfulfilled demand at demand node j.

   Formulate this problem as a standard transportation problem with total supply equal to total demand.
3. A police department in a small city consists of three precincts denoted by p_1, p_2 and p_3. Each precinct is assigned a number of patrol cars equipped with two-way radios and first-aid equipment. The department operates with three shifts. The minimum and maximum number of patrol cars needed in each shift are shown below.

   Minimum required

	Shift 1	Shift 2	Shift 3
p_1	2	4	3
p_2	3	6	5
p_3	5	7	6

   Maximum required

	Shift 1	Shift 2	Shift 3
p_1	3	7	5
p_2	5	7	10
p_3	8	12	10

   Administrative constraints require that
   (a) shifts 1, 2 and 3 have, respectively, at least 10, 20, and 18 cars available; and
   (b) precincts p_1, p_2, and p_3 are, respectively, allocated at least 10, 14 and 13 cars.

   The police department wants to determine an allocation of patrol units that will meet all the requirements with the fewest possible units committed to the field. Formulate this problem as a circulation problem.

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[*] Homework due in class one week after assigned. No late homework accepted.